

## **Mediated Electrochemical Oxidation as an Alternative to Incineration for Mixed Wastes\***

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Mediated Electrochemical Oxidation (MEO) is an aqueous process which oxidizes organics electrochemically at low temperatures and ambient pressures. The process can be used to treat mixed wastes containing organics by destroying the organic components of the wastes. The radioactive components of the wastes are dissolved in the electrolyte where they can be recovered if desired, or immobilized for disposal.

The process of destroying organics is accomplished via a mediator, which is in the form of metallic ions in solution. The ions, initially at their lower valence state, are oxidized to a higher valence state at the anode surface. The oxidized ions in turn destroy organics throughout the bulk of the fluid. This results in a very efficient process, since the system can be optimized to oxidize the mediator at the anode, while the organics are dispersed at low concentrations throughout the anolyte. At LLNL we have worked with several mediators, including silver, cobalt and cerium. We have tested mediators in nitric as well as sulfuric acids.

We have recently completed extensive experimental studies on cobalt-sulfuric acid and silver-nitric acid systems for destroying the major organic components of Rocky Flats Plant combustible mixed wastes. The study was conducted on small-scale laboratory equipment and on a bench-scale facility that incorporated an industrial-sized electrochemical reactor. Organics tested were: Trimsol (a cutting oil), cellulose (including paper and cloth), plastics (Tyvek, polyethylene and polyvinyl chloride) and biomass (bacteria). The process was capable of destroying almost all of the organics tested, attaining high destruction efficiencies at reasonable current efficiencies. The only exception was polyvinyl chloride, which was destroyed very slowly resulting in poor current efficiencies.

Besides the process development work mentioned above, we are working on the design of a pilot-plant scale integrated system to be installed in the Mixed Waste Management Facility (MWMF) at LLNL. In addition to the electrochemical

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process, this system will comprise the requisite secondary processes to replenish the reagents for continuous operation. These include processes for electrolyte regeneration and mediator recovery. The system will also be completely integrated with upstream and downstream processes (for example, feed preparation, off-gas and water treatment, and final forms encapsulation). The conceptual design for the MEO-MWMF system has been completed and preliminary design work has been initiated.

In conclusion, Mediated Electrochemical Oxidation is an aqueous low-temperature, low-pressure process capable of destroying a variety of organics. It can be used in treating mixed wastes containing significant amounts of organics by destroying the organic component of wastes. The primary (electrochemical) process has been demonstrated at a bench-scale level on a number of combustible organics of interest to the DOE Complex. Plans are currently in progress to demonstrate this process in an integrated facility that will manage mixed wastes, starting from the initial feed preparation to the final discharge of gaseous effluents, sewerable water, and immobilized solids, in compliance with all applicable regulatory requirements.